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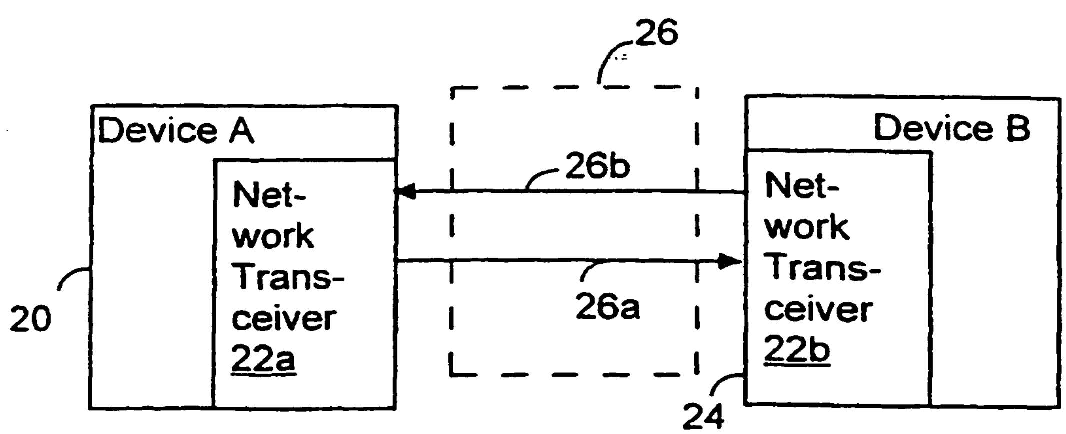
(54) Title: A TRANSCEIVER WITH AUXILIARY MONITORING PORTS



(57) Abstract: A transceiver allows a monitoring device to be coupled and decoupled without interrupting communication between a pair of devices, one of which includes the transceiver. The transceiver includes three pairs of ports and two pairs of buffers. The first send and receive port accommodate coupling to a host device including the transceiver and the second send and receive ports accommodate coupling to a transmission line. The third pair of ports are monitoring ports for coupling to a monitoring device. The first pair of buffers form a bidirectional communication link between the first send and receive ports and the second send and receive ports. The second pair of buffers form a unidirectional communication link transmitting signals to the monitoring device.

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A TRANSCEIVER WITH AUXILIARY MONITORING PORTS

The present invention relates generally to transceivers, and particularly to a transceiver including a supplemental unidirectional communications link and monitoring ports to which a monitoring device can be coupled.

BACKGROUND OF THE INVENTION

Network maintenance is challenging regardless of network type: Fibre Channel, Gigabit Ethernet or Intel Corporation's System Input/Output (SIO). Network users want the network maintained and improved, but do not want their service interrupted. No satisfactory means allows simultaneous satisfaction of both user demands.

Figures 1 and 2 indicate why simultaneously satisfying both demands is difficult. In Figure 1 Device A 20 and Device B 24 are coupled to one another via a bi-directional communication link 26, also called transmission line 26. Communication link 26 includes transmission line 26a, which transmits signals from Device A 20 to Device B 24, and transmission line 26b, which transmits signals from Device B 24 to Device A 20. Device A 20 and Device B 24 use a different type of signaling than that used by communication link 26. For example, Device A 20 and Device B 24 may use electrical signaling and communication link 26 may use optical signaling. Because of these signaling differences Device A 20 and Device B 24 each include a Network Transceiver 22 to transduce the signals sent to and received from communication link 26.

Figure 2 illustrates a prior Network Transceiver 22, which includes two pairs of ports 40 & 42 and 44 & 46. As used herein, "port" refers to a signal interface, a point at which signals enter or exit a circuit, without regard to the signal or connector type. Each pair of ports includes a receive port and a send port. Host Send and Receive Ports 40 and 42 mate to connectors of a host device (20, Figure 1), while Line Send and Receive Ports 44 and 46 mate to communication link 26. Host Send Port 40 transmits signals from the host device to Line Send Port 44 via Buffering Isolation Circuit 48. Similarly, Line Receive Port 46 transmits signals from the transmission line to Host Receive Port 42 via Buffering Isolation Circuit 49.

Thus, Buffering Isolation Circuits 48 and 49 form a bidirectional communications link between the two pairs of Ports 40 & 42 and 44 & 46. Host Send and Receive Ports 40 and 42 are typically located within the host device, making them practically inaccessible. In contrast, Line Send and Receive Ports 44 and 46 are typically located on an exterior surface of a host device, making them much more accessible. Thus, a monitoring device attempting to determine what signals Device A 20, for example, is sending and receiving must mate with the Line Send Port 44 of Device A 20 and the Line Send Port 44 of Device B 24.

Figure 3 illustrates one prior art configuration for testing communication link 26 between Device A 20 and Device B 24. Testing according to this configuration requires temporarily interrupting communication link 26 to insert Monitoring Device 30. Using two Network Transceivers 22c and 22d, Monitoring Device 30 functions both as part of communication link 26 and a monitoring device. Permanent installation of Monitoring Device 30 would satisfy the demand for monitoring without interruption; however, given that a monitoring device like a protocol analyzer costs may cost $50,000 or more, permanent installation of Monitoring Device 30 is not feasible.

Figure 4 illustrates another prior art network configuration 50 for monitoring communication link 26, between Device A 20 and Device B 24. Network configuration 50 permits monitoring of communication link 26 without interrupting communication between Device A 20 and Device B 24. Network configuration 50 includes two Splitters 52a and 52b inserted into communication link 26. Splitters 52a and 52b may be permanently installed because they are relatively inexpensive. Splitters 52a and 52b allow Monitoring Device 30 to be coupled and decoupled from communication link 26 without interruption. While inexpensive in a monetary sense, Splitters 52a and 52b are expensive in terms of power efficiency, reducing by 3 dB the power they transmit as compared to the power they receive. Such a large power reduction may be unacceptable in networks with long transmission lines.

Figure 5 illustrates another network configuration 60 for monitoring communications between Device A 20 and Device B 24. Network configuration 60 inserts Network Hub 62 into communication link 26. Network Hub 62 permits coupling and decoupling of Monitoring Device 30 without interruption and without the power losses associated with power splitters. If inexpensive, Network Hub 62 may be permanently installed; however, an inexpensive network hub increases signal jitter to the detriment of network performance. If an expensive Network Hub 52 is used, it causes little signal jitter; however, its increased

expense renders it unsuitable for permanent installation (which in turn requires interruption of network service to install it when needed for network maintenance or monitoring).

Thus, a need exists for an inexpensive network device or configuration that permits monitoring of network devices and communication links without interrupting communications or degrading network performance.

SUMMARY OF THE INVENTION

The Transceiver of the present invention allows a monitoring device to be coupled and decoupled without interrupting communication between a pair devices, one of which includes the present Transceiver. The Transceiver includes three pairs of ports and two pairs of buffers. The first send and receive ports accommodate coupling to a host device and the second send and receive ports accommodate coupling to a transmission line. The third pair of ports are monitoring ports for coupling to a monitoring device. The first pair of buffers form a bidirectional communication link between the first send and receive ports and the second send and receive ports. One of the first pair of buffers transmits signals from the first sent port to the second port, while the other of the first pair of buffers transmits signals from the second receive port to the first receive port. The second pair of buffers form a unidirectional communication link transmitting signals to the monitoring ports. One of the second pair of buffers transmits signals from the first send port to a first of the pair of monitoring ports, while the other of the second pair of buffers transmits signals from the first receive port (or the second receive port) to a second of the pair of monitoring ports.

BRIEF DESCRIPTION OF THE DRAWINGS

Additional objects and features of the invention will be more readily apparent from the following detailed description and appended claims when taken in conjunction with the drawings, in which:

Figure 1 is a block diagram of a network configuration including a prior Transceiver.

Figure 2 is a block diagram of the prior Transceiver.

Figure 3 is a block diagram of a prior network configuration for monitoring a link between two devices.

Figure 4 is a block diagram of a second prior network configuration for monitoring a link between two devices.

Figure 5 is a block diagram of a third prior network configuration for monitoring a link between two devices.

Figure 6 is a block diagram of a network configuration for monitoring a link between two devices, one of which includes the present Transceiver.

Figure 7 is a block diagram of an embodiment the present Transceiver.

Figure 8 is a more detailed block diagram of the embodiment of the present Transceiver shown in Fig. 7.

Figure 9 is a plan side view of a housing enclosing an embodiment of the present Transceiver.

Figure 10 is a plan view of the nose of the housing enclosing an embodiment of the present Transceiver.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 6 illustrates in block diagram form network configuration 70, which includes Transceiver 72 of the present invention. Network configuration 70 accommodates the coupling and decoupling of Monitoring Device 30 without breaking communication link 26 between Device B 24 and Device C 21. This flexibility arises from the inclusion in Device C 21 of Transceiver 72, rather than prior Transceiver 22. Transceiver 72 includes a unidirectional communication link and an additional pair of externally accessible monitoring ports, to which Monitoring Device 30 may be coupled and decoupled. This enables Monitoring Device 30 to monitor both the signals sent by and received by Device C 21.

Figure 7 illustrates Transceiver 72 in block diagram form. Transceiver 72 includes, in addition to the circuitry of prior Transceiver 22, Monitor Port1 74, Monitor Port2 76 and Unidirectional Communication Link 78. Monitor Port1 74 allows Monitoring Device 30 to monitor the signals being sent from Device 21 and Monitor Port2 76 allows Monitoring Device 30 to monitor the signals sent to (and received by) Device C 21. Unidirectional

Communication Link 78 captures signals sent and received by Device C 21 and couples them to Monitor Port1 74 and Monitor Port2 76. Within Unidirectional Communication Link 78 the flow of signals is away from the host device, in contrast to the bidirectional communication link formed by Buffering Isolation Circuits 48 and 49, in which signals flow to and from the host device.

Unidirectional Communication Link 78 includes Buffering Isolation Circuits 80 and 86. Buffering Isolation Circuit 80 receives signals sent by Device C 21 via Buffering Isolation Circuit 48 and couples them to Monitor Port2 74. The precise point at which Buffering Isolation Circuit 80 taps into the signal path of Buffering Isolation Circuit 48 is a design choice. Buffering Isolation Circuit 80 includes Buffer 82 and Isolation Circuit 84. Buffering Isolation Circuit 86 receives from Buffering Isolation Circuit 49 the signals sent to Device C 21 and couples those signals to Monitor Port2 76. The precise point at which Buffering Isolation Circuit 86 taps into the signal path of Buffering Isolation Circuit 49 is a design choice. Buffering Isolation Circuit 86 includes Buffer 88 and Isolation Circuit 90.

Figure 8 illustrates, in a more detailed block diagram form, an embodiment of Transceiver 72a that uses differential signaling throughout and electronic signaling at Host and Monitor Ports 40, 42, 74 and 76 and optical signaling at Line Ports 44 and 46. Transceiver 72a may be easily adapted to handle the various combinations of signaling at all ports of Transceiver 72. Buffering Isolation Circuit 48a includes Isolation Circuit 100, Buffer 102 and Isolation Circuit 104. Isolation Circuit 100 is realized as a pair of capacitors, Buffer 102 as a differential buffer and Isolation Circuit 104 as a transformer. The difference in Isolation Circuits 100 and 104 arises from designer choice involving component physical size and requirements for electrostatic discharge protection and common mode noise rejection. Buffering Isolation Circuit 49a is implemented in a similar fashion to Buffering Isolation Circuit 48a. Buffering Isolation Circuit 80a includes a differential buffer, Buffer 82a, and Isolation Circuit 84a, realized as a pair of capacitors. Buffering Isolation Circuit 86 is implemented in a similar fashion to Buffering Isolation Circuit 80a.

In the embodiment shown in Figure 8, the Buffering Isolation Circuits 48a and 49a are both coupled to the signal paths at points separated from the Host ports 40, 42 only by Isolation Circuits 100, 110. These are particularly good points in the signal paths to couple the Buffering Isolation Circuits 48a and 49a because the host send and receive signals are known to be strong (i.e., to have good signal to noise ratio) at this point, and therefore the

circuit load presented by the Buffering Isolation Circuits 48a and 49a will have negligible effect on the signals being sent and received. However, in other embodiments the Buffering Isolation Circuits 48a and 49a could be coupled to other points in the send and receive signal paths within the Buffering Isolation Circuits 48a and 49a.

The differential buffers 82a, 88a, 102a and 112a are preferably very low noise signal amplifiers.

In an alternate embodiment, in which the line send and receiver ports 44, 46 are optical fiber ports, Isolation Circuit 104 is a laser diode transmitter, and Isolation Circuit 114 is a photodiode receiver suitable for converting laser light into an electrical signal.

Figure 9 is a plan side view of Housing 130, which encloses Transceiver 72. Housing 130 includes two sections, Body 132 and Nose 134. The dimensions of Body 132 conform to a predefined form factor so that Body 132 may be electrically coupled to Device C 21 (Figure 6) by insertion into a transceiver receptacle in the Device C 21. Preferably, the dimensions of Body 132 are identical to those of prior Transceiver 22. Body 132 includes a Main Section 136 and Tail Section 138, in which Host Send and Receive Ports 40 and 42 are mounted. At the opposite end of Housing 130, Line and Monitor Ports 44, 46 and 74 and 76 are mounted in Nose 134. To accommodate Monitor Port1 74 and Monitor Port2 76, Nose 134 includes Hat 140. Hat 140 increases the dimensions of Nose 134 sufficiently as compared to the nose dimensions of the housing of prior Transceiver 22 to accommodate Monitor Port1 74 and Monitor Port2 76. For example, when Monitor Port1 74 and Monitor Port 2 76 each include 3 pin sockets, the height of Hat 140 may be as little as approximately 0.25 inches.

Figure 10 is a plan front view of Nose 134, which is externally accessible to users desiring to couple or decouple Monitoring Device 30 to Transceiver 72. Figure 10 illustrates the relative location of Line Send and Receive Ports 44 and 46 to Monitor Port1 74 and Monitor Port2 76. All portrayed as female connectors, Ports 44, 46, 74 and 76 may also be realized as male connectors. Line Send and Receive Ports 44 and 46 are located adjacent to one another and below Monitor Port1 74 and Monitor Port2 76. In one preferred embodiment Line Send and Receive Ports 44 and 46 are realized as optical fibre sockets, and in another preferred embodiment Line Send and Receive Ports 44 and 46 are realized as coaxial cable sockets. In yet another embodiment, Ports 44 and 46 are realized as two pair of differentially driven signal pins in a connector.

Monitor Port1 74 and Monitor Port2 76 are located adjacent to one another and above Line Send and Receive Ports 44 and 46, and are preferable realized as electrical pin sockets.

Alternate Embodiments

While the present invention has been described with reference to a few specific embodiments, the description is illustrative of the invention and is not to be construed as limiting the invention. Various modifications may occur to those skilled in the art without departing from the true spirit and scope of the invention as defined by the appended claims.

WHAT IS CLAIMED IS:

1. A transceiver comprising:

first send and receive ports, for coupling to a host device;

second send and receive ports, for coupling to a transmission line;

first and second monitoring ports, for coupling to a monitoring device;

a first pair of buffers, for transmitting signals from the first send port to the second send port and for transmitting signals from second receive port to the first receive port, the first pair of buffers forming a bidirectional communication link;

a second pair of buffers, for transmitting signals from the first send port to the first monitoring port and for transmitting signals from second receive port to the second monitoring port, the second pair of buffers forming a unidirectional communication link.

2. The transceiver of claim 1, further comprising

a housing having first and second opposing ends, the first send and receive ports mounted at first end of the housing, and the second send and receive ports and the first and second monitoring ports mounted at the second end of the housing.

3. The transceiver of claim 1, further comprising

a housing having first and second sections, the first section having a first width and height that conform to a predefined form factor associated with a receptacle into which the transceiver may be inserted, the second section having at least a second height larger than the first height, wherein the second section remains substantially outside the receptacle when the transceiver is inserted therein.

4. The transceiver of claim 3, wherein

the second send and receive ports and the first and second monitoring ports are mounted in the second section of the housing.

5. The transceiver of claim 1, wherein the second pair of buffers have inputs coupled to the first send port and first receive port.

6. A transceiver, comprising:

first send and receive ports for coupling to a host device;

second send and receive ports for coupling to a channel;

first and second monitoring ports for coupling to a monitoring device;

a first buffer and a second buffer, the first buffer transmitting signals from the first send port to the second send port and the second buffer transmitting signals from the second receive port to the first receive port, the first and second buffers forming a bidirectional communication link;

a first and a second buffering isolation circuit, the first buffering isolation circuit transmitting signals from the first send port to the first monitoring port, and the second buffering isolation circuit transmitting signals from an output of the second buffer to the second monitoring port, the first and second buffering isolation circuits forming an uni-directional communication link; and

a housing having first and second sections, the first section having a first width and height that conform to a predefined form factor associated with a receptacle into which the transceiver may be inserted, the second section having a second height larger than the first height, wherein the second section remains substantially outside the receptacle when the transceiver is inserted therein.

7. The transceiver of claim 6, wherein

the second send and receive ports and the first and second monitoring ports are mounted in the second section of the housing.

8. The transceiver of claim 7, wherein

the housing has first and second opposing ends, the first send and receive ports mounted at first end of the housing, and the second send and receive ports and the first and second monitoring ports mounted at the second end of the housing.

9. The transceiver of claim 7, wherein the second height is greater than the first height by approximately 0.25 inches.

10. The transceiver of claim 7, wherein the second send and receive ports each include an optical connector and the first and second monitoring ports each include an electrical connector.

11. The transceiver of claim 10, wherein the first and second monitoring ports are mounted above the second send and receive ports.

12. The transceiver of claim 6, wherein the first and second buffering isolation circuits each comprise:

a differential buffer having a pair of outputs each coupled to an isolation circuit.

13. The transceiver of claim 12, wherein each isolation circuit comprises a capacitor.

14. The transceiver of claim 6 wherein the first and second buffers are differential buffers.

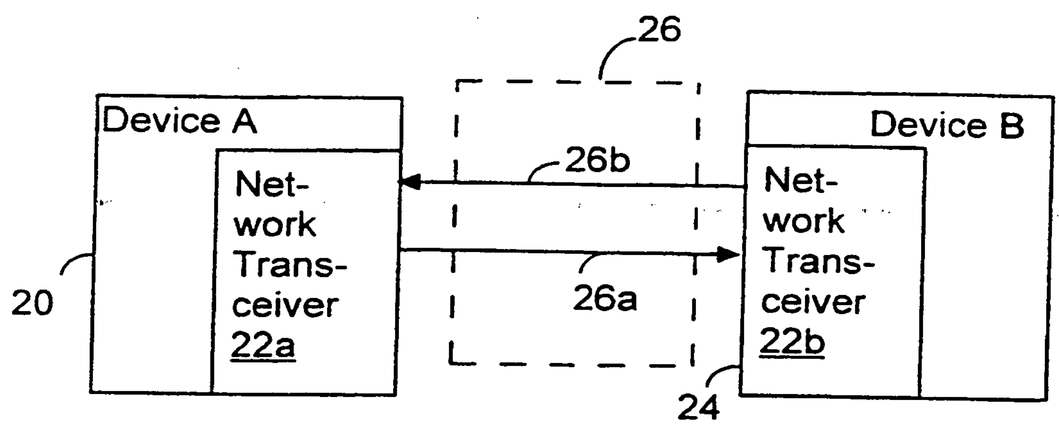

FIG. 1
(Prior Art)

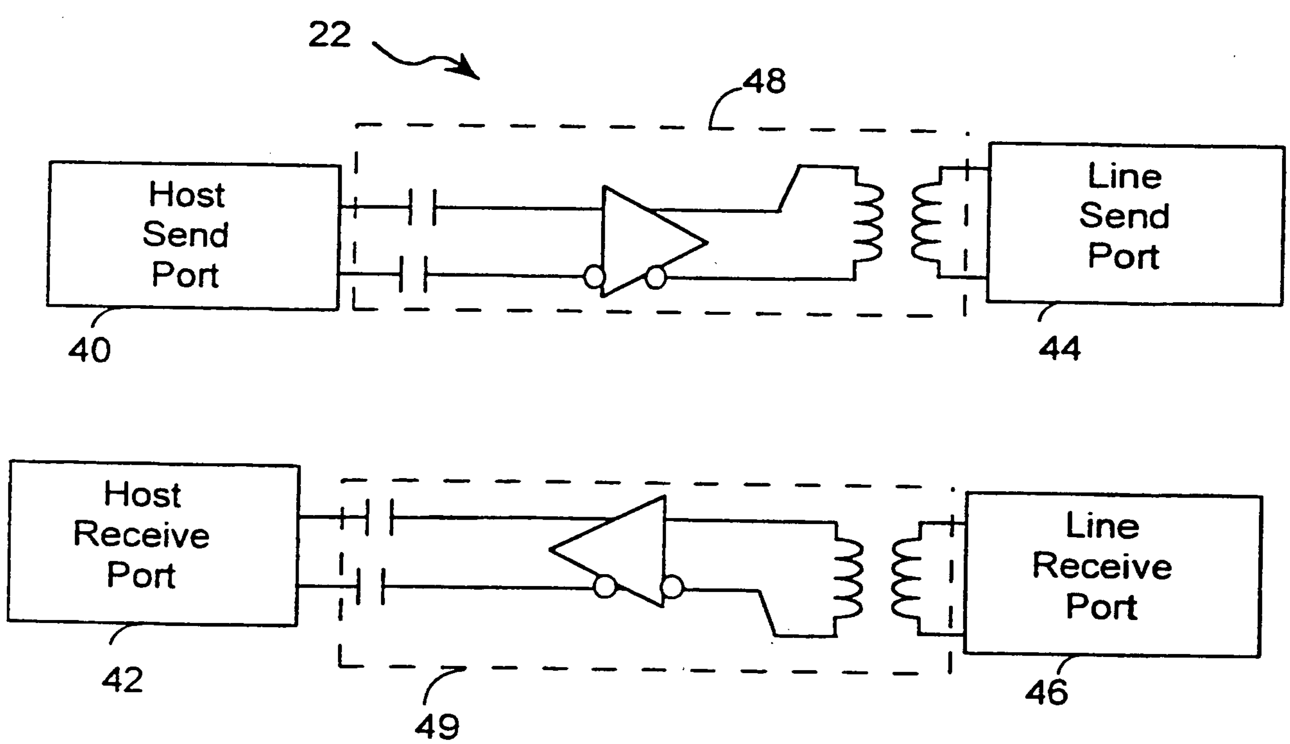

FIG. 2
(Prior Art)

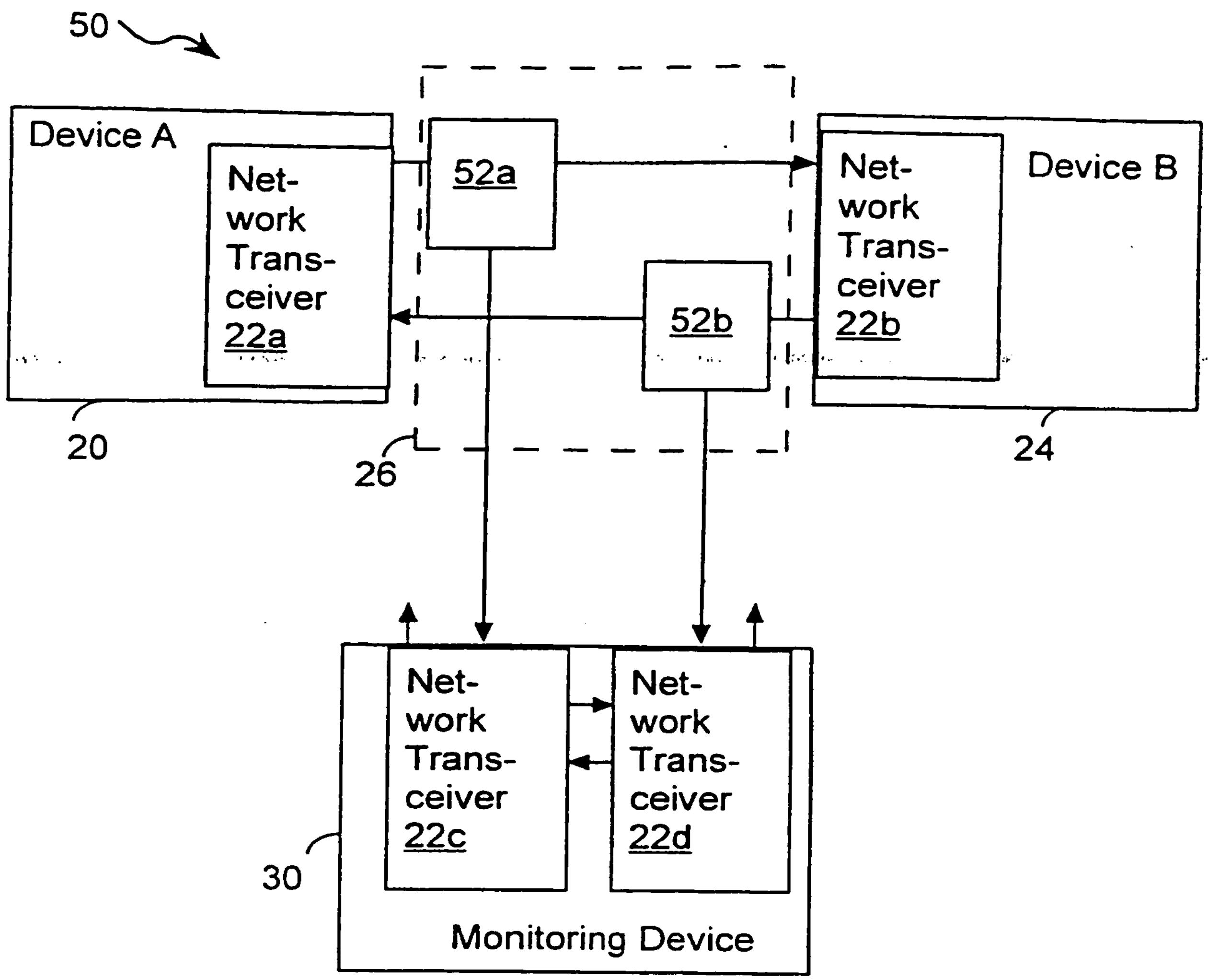

FIG. 4
(Prior Art)

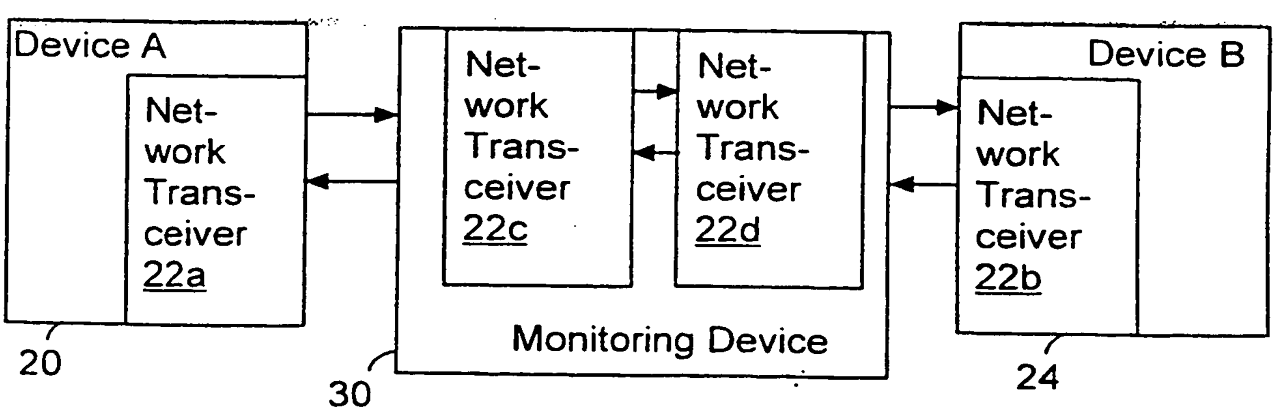

FIG. 3
(Prior Art)

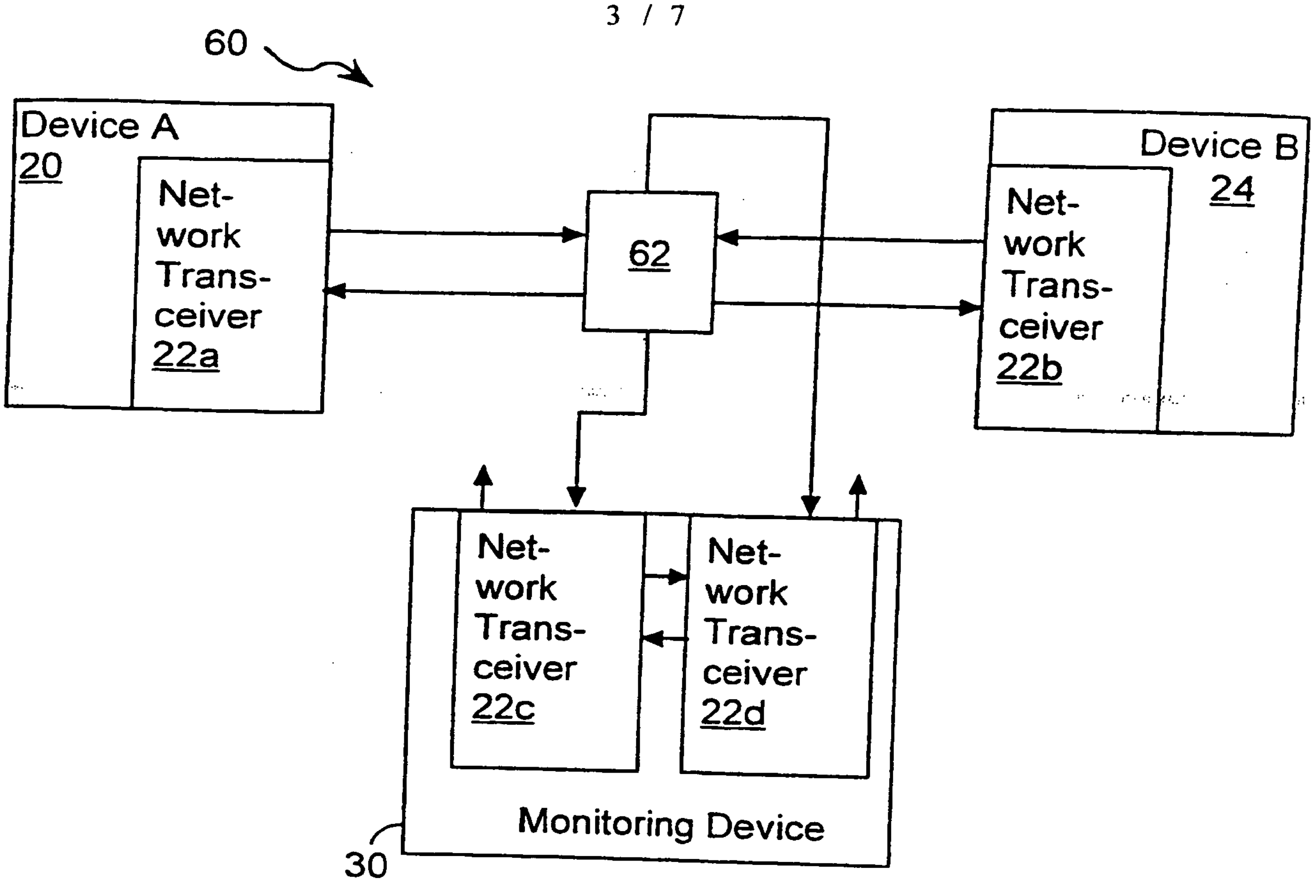

FIG. 5

(Prior Art)

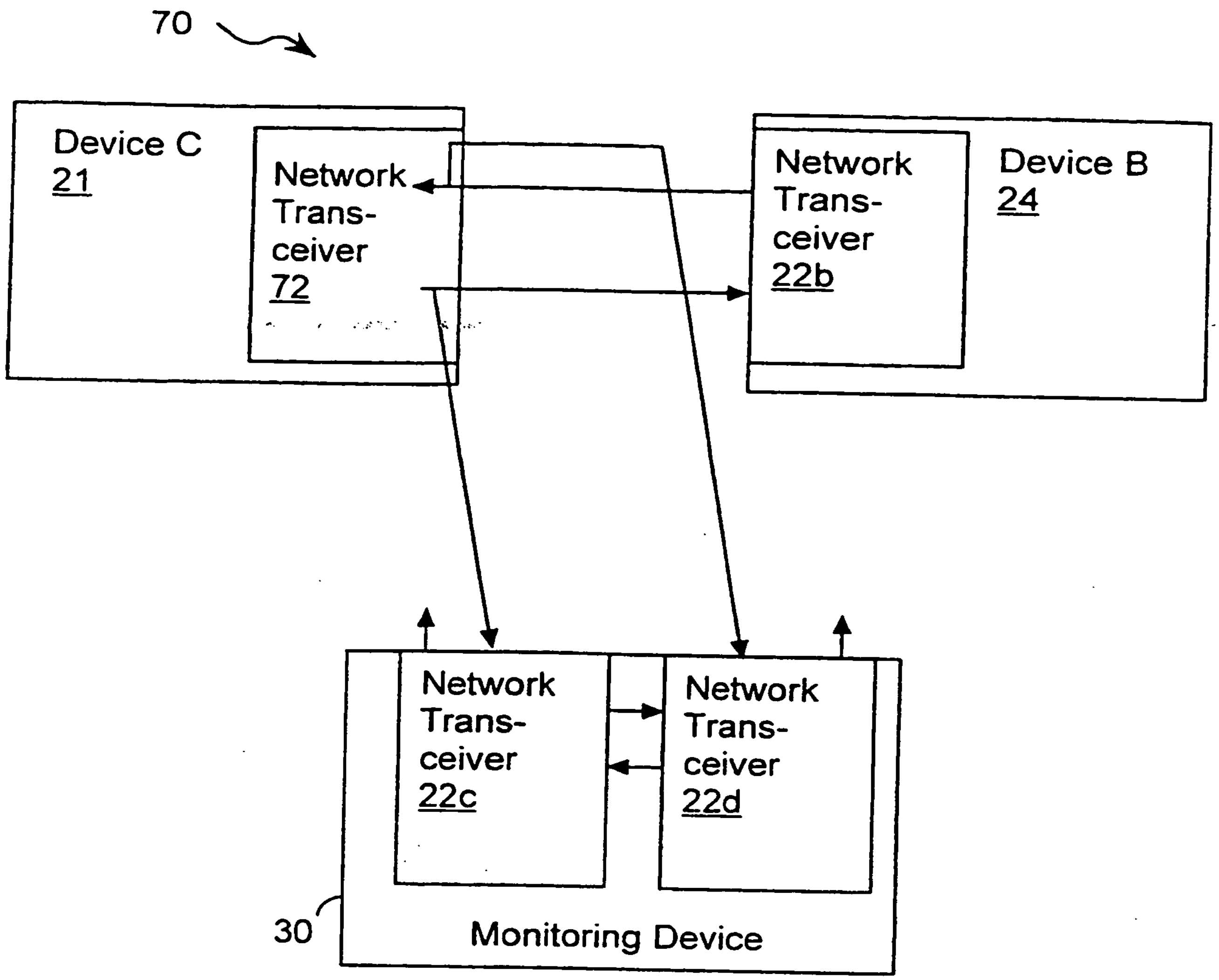
70
Device C
21
Network
Trans-
ceiver
72
Network
Trans-
ceiver
22b
Device B
24
Network
Trans-
ceiver
22c
Network
Trans-
ceiver
22d
30
Monitoring Device

FIG. 6

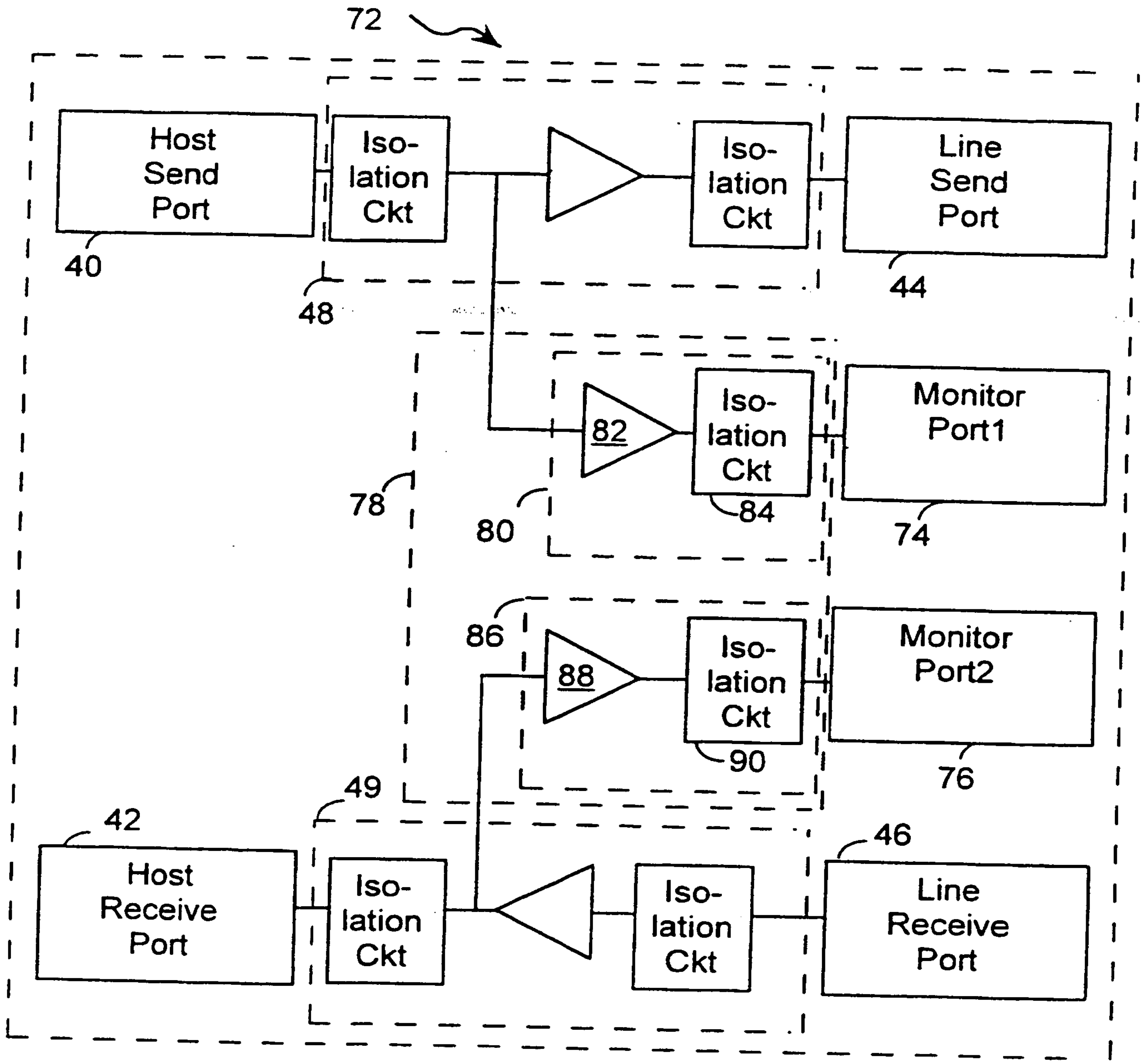
72
Host Send Port
40
Iso-lation Ckt
48
Iso-lation Ckt
Line Send Port
44
78
80
82
Iso-lation Ckt
84
Monitor Port1
74
86
88
Iso-lation Ckt
90
Monitor Port2
76
49
42
Host Receive Port
Iso-lation Ckt
Iso-lation Ckt
46
Line Receive Port

FIG. 7

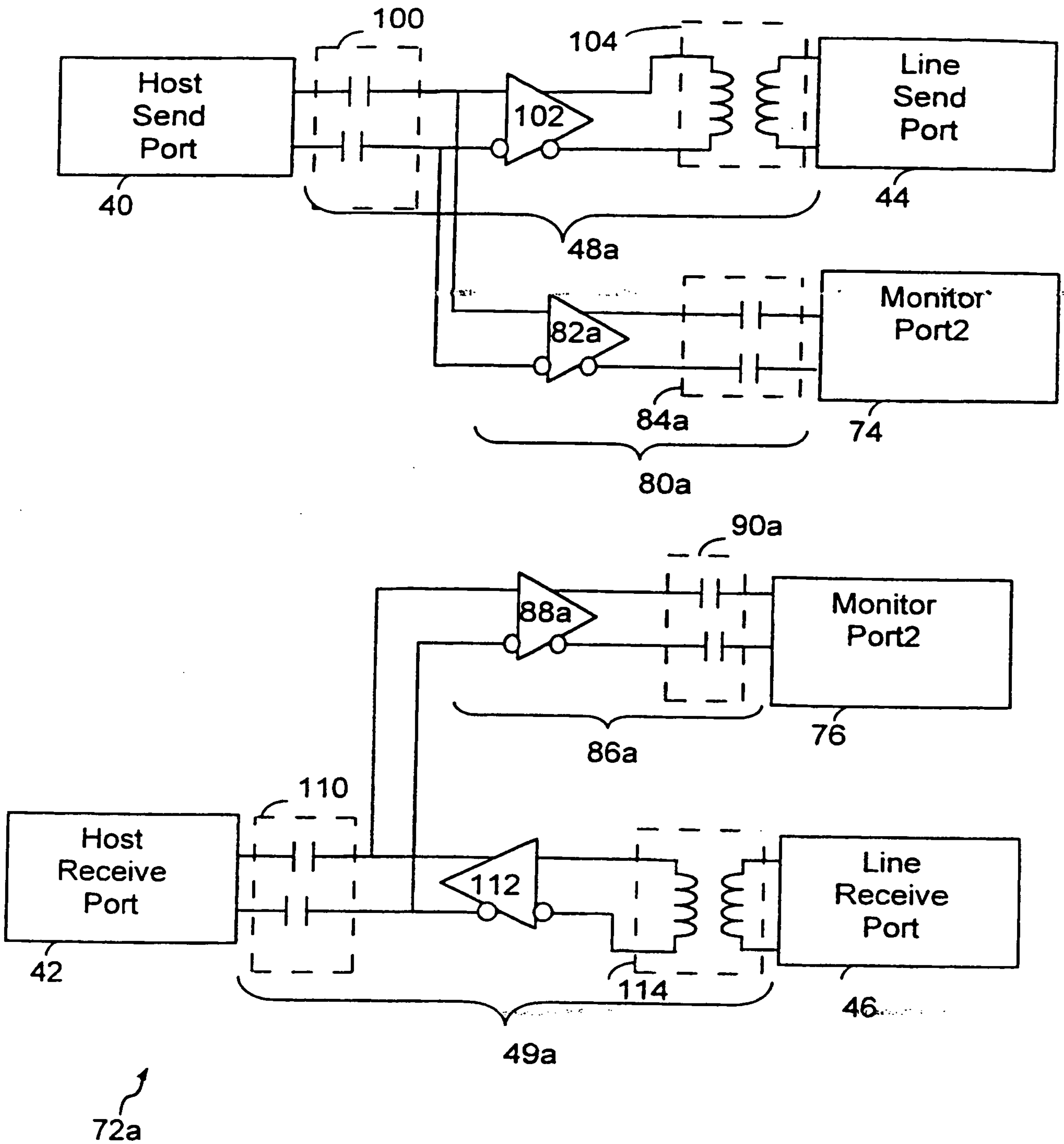
100
104
Host
Send
Port
102
Line
Send
Port
40
44
48a
82a
Monitor
Port2
84a
74
80a
90a
88a
Monitor
Port2
76
86a
110
Host
Receive
Port
112
Line
Receive
Port
42
114
46
49a
72a

FIG. 8

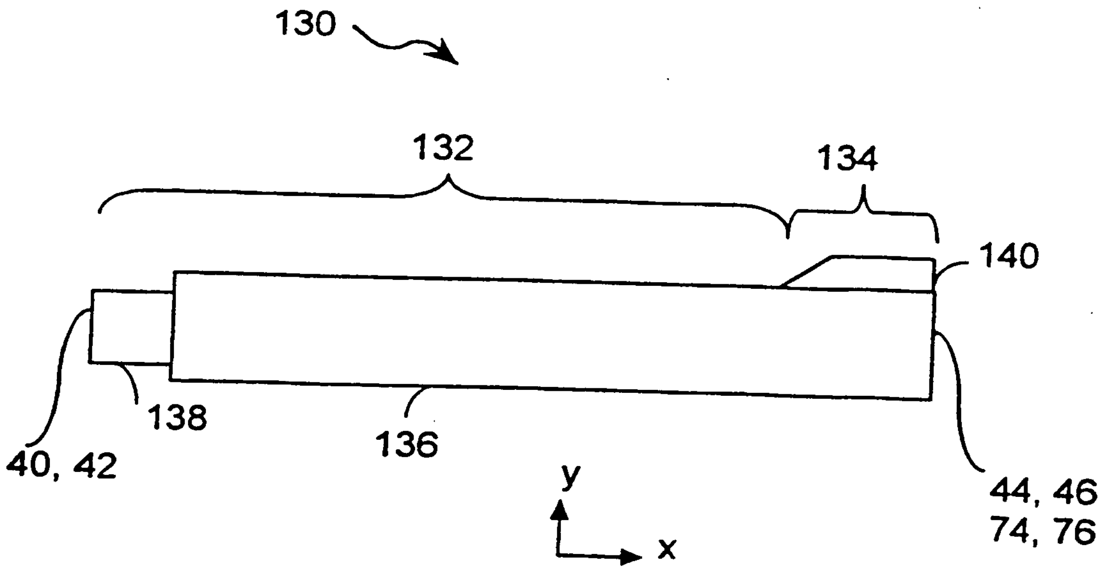

FIG. 9

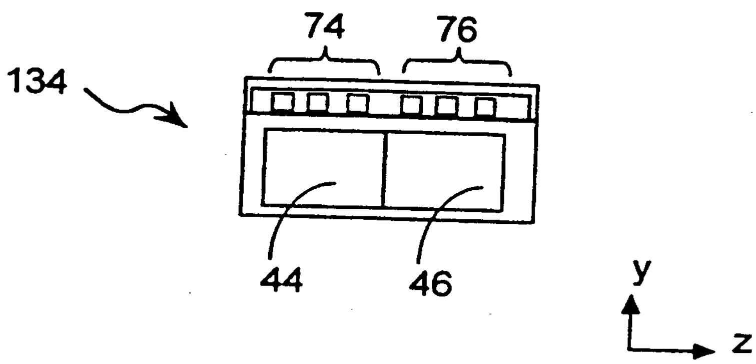

FIG. 10

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(84) Designated States *(regional)*: European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

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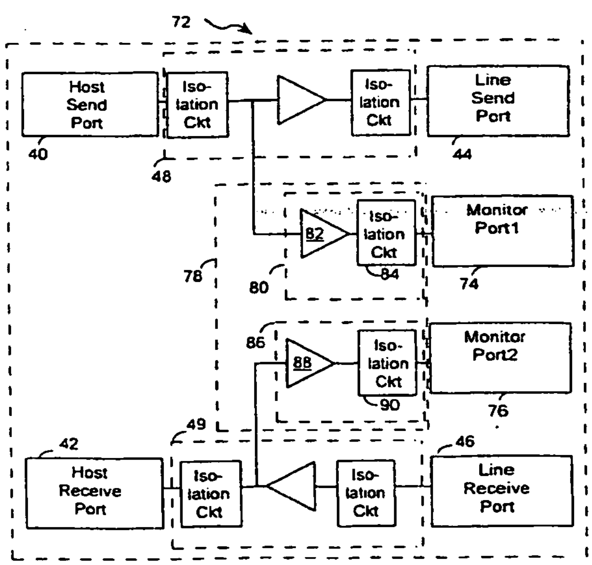

(57) Abstract: A transceiver (72) allows a monitoring device (30) to be coupled and decoupled without interrupting communication between a pair of devices, one of which includes the transceiver. The transceiver includes three pairs of ports and two pairs of buffers. The first send and receive ports (40, 42) accommodate coupling to a host device (20) including the transceiver and the second send and receive ports (44, 46) accommodate coupling to a transmission line. The third pair of ports (74, 76) are monitoring ports for coupling to the monitoring device. The first pair of buffers form a bidirectional communication link between the first send and receive ports and the second send and receive ports. The second pair of buffers (82, 88) form a unidirectional communication link transmitting signals to the monitoring device.

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

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US CL :370/245, 419
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 370/230, 245, 252, 254, 419, 465

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EAST
search terms: transceiver, monitoring device, monitoring port

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,754,552 A (ALLMOND et al) 19 May 1998, col. 5, line 57-col. 7, line 42.	1-14
Y	US 5,671,355 A (COLLINS) 23 September 1997, col. 7 line 31-col. 10, line 36.	1-14
Y	US 5,884,040 A (CHUNG) 16 March 1999, col. 6, line 44-col. 7, line 25.	1-14

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☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
29 MARCH 2001	27 APR 2001
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